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Exploring linkages between climate change and sexual health: A scoping review protocol

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Abstract

Introduction

The effects of climate change and associated extreme weather events present substantial threats to health and wellbeing. Conceptual frameworks signal the ways in which extreme weather events can harm sexual health, such as through elevated exposure to HIV and other sexually transmitted infections (STI), disrupted health care access, and increased sexual and gender-based violence (SGBV). The World Health Organization (WHO) defines four components of sexual health: comprehensive sexuality education; HIV and STI prevention and care; SGBV prevention and care; and psychosexual counselling. Yet knowledge gaps remain regarding climate change and its associations with these multiple sexual health domains. This scoping review will therefore explore the linkages between climate change and sexual health outcomes.

Methods and analysis

Four electronic databases, MEDLINE, EMBASE, PsycINFO, and CINAHL, will be searched using text words and subject headings (e.g., MeSH, Emtree) related to sexual health and climate change. Grey literature and unpublished reports will also be searched, including from the WHO, World Bank eLibrary, and the Centers for Disease Control and Prevention. The scoping review will consider studies that explore: a) climate change and extreme weather events including droughts, heat waves, wildfires, dust storms, hurricanes, flooding rains, coastal flooding, and storm surges; alongside b) sexual health, including: comprehensive sexual health education and information, sexual health counselling, and HIV and other STI acquisition, prevention and/or care, and/or SGBV, including intimate partner violence, sexual assault and rape. We will consider quantitative, qualitative, mixed-methods, and review articles for inclusion. We will conduct thematic analysis of findings and apply sex and gender-based analysis. Data will be presented both in narrative and tabular forms.

Ethics and dissemination

There are no formal ethics requirements as we are not collecting primary data. Results will be published in a peer-reviewed journal and shared at national and international conferences.

Keywords: HIV & AIDS, public health, tropical medicine

Strengths and limitations of this study

- This scoping review will offer an innovative and comprehensive approach to climate change and associations with multiple sexual health domains, including sexual education, HIV and STI prevention, treatment
- At both screening stages, reviewers will first assess a random selection of articles to establish and document a common understanding of the nuances of the inclusion/exclusion criteria; a process that will be documented and included in the publishing of the results.
- No limitations on date, location, or language are incorporated into the search strategy, maximizing the ability to find all relevant peer reviewed literature.
- The comprehensive database search will be bolstered by a grey literature search of major global organizations likely to have reporting on this intersection.
- As terminology for climate change and extreme weather events is evolving and connected to the larger planetary health field, newly emerging terms may not be included in our search.

Background

Climate change is one of the greatest threats to health and wellbeing in the 21st century.(1,2) In addition to warming temperatures and heat extremes, floods, droughts, wildfires, increased frequency of intense storms, and other extreme weather events are linked to climate change, and have impacts on human health and wellbeing.(3) Direct and indirect health effects of extreme weather events include malnutrition, poverty, poor mental health non-communicable diseases, and infectious diseases.(4) An emerging literature signals the importance of attending to the linkages between climate change and sexual health outcomes.(5,6) HIV is an illustrative example, with prevalence highest in Sub-Saharan Africa, a region that is highly impacted by climate change and associated extreme weather events such as drought (1,7–9), as well as Caribbean contexts such as Haiti. (10–12)

Climate change impacts broader environmental systems to increase strain on global food and water supplies.(2,13,14) Drought can increase food insecurity,(15–17) migration,(18–20) and disrupt both provision of—and access to—health services.(13) Food insecurity is associated with HIV acquisition risks through behavioural (e.g. transactional sex) and mental health (e.g., alcohol use, depression) pathways.(21,22) Food insecurity has also been associated with increased sexual risk practices among HIV-positive youth in Sub-Saharan Africa(23) and increased transactional sex and reduced safer sex efficacy among HIV-positive women.(24) It has also been linked with reduced condom efficacy among adolescents(25) and reduced condom use with adults.(26) Drought is also linked with HIV vulnerabilities, largely through reduced income.(9) Water insecurity and linkages with HIV acquisition and other sexual health outcomes are understudied,(27) as is the nexus of climate change, food and water insecurity, and sexual health outcomes.(5)

Both HIV and other sexually transmitted infections (STIs), as well as climate change and extreme weather events, disproportionately affect marginalized persons, including adolescent girls and young women, migrants, sexually and gender diverse persons, and persons living in poverty.(6,28–33) For instance, Burke et al. found that in a study of 2000 people across 19 Sub-Saharan African countries, a rainfall shock (annual rain less than the 15th percentile of the local area’s historical rainfall distribution) was associated with an 11% increase in HIV prevalence among rural populations that had a high HIV prevalence at baseline.(9) In another study in Lesotho, a drought in the past two years was linked with higher HIV prevalence among adolescent girls in rural areas, but not among boys.(8) Baker modelled the effects of climate change using datasets including 400,000 persons across 25 Sub-Saharan African countries, specifically examining impacts of long-term temperature increases on HIV prevalence.(34) Warmer time periods were associated with increased HIV prevalence, and this increase was higher in rural regions and with younger age groups, and may be linked with men’s migration and engagement in transactional sex.(34) The effects of climate change are often unequal and disproportionately impact populations who have contributed the least to the crisis.(2,35,36) The 2020 Lancet Countdown report indicates that climate change and its contribution to extreme weather events and rising sea levels will increase human migration and displacement, both of which ultimately impact human health,(2) including risks of poorer sexual health outcomes.(37,38)

An ecosocial theoretical approach considers how hazardous environments, poverty, and social inequities are embodied.(39) The resource scarcity framework conceptualizes shared structural drivers as social (e.g. gender norms), economic (e.g. poverty), and ecologic (e.g. climate change) factors that contribute to water and food insecurity and ultimately to wellbeing.(40,41) Several conceptual frameworks have linked ecosocial factors to HIV and STI vulnerabilities and other sexual health concerns. Tallman et al. applied the ecosyndemic approach to understand the ways through which building dams and highways in tropical forests in Brazil and Peru was linked with vector-borne infections, sex work, and increased STIs.(42) The ecosyndemics framework examines the ways in which largely human-caused environmental changes interact with economic and social inequities to harm health.(43–45) Mapping ecosyndemic risk hotspots and community engagement can provide insight into how social and ecological system changes interact to shape STI and other health concerns.

Lieber et al. conceptualized four paths from climate change to HIV and AIDS, including increased migration, infectious diseases, infrastructure erosion, and food insecurity.(5) For instance, extreme weather events such as drought and flooding have been linked with elevated sexual risk practices including condomless and transactional sex (8,46) and early sexual debut.(9) Extreme weather events may also result in long and short-term migration (47–50) that is associated with increased sexual networks and sexual exploitation.(51,52) Infectious diseases, such as malaria, dengue, chikungunya, and Lyme disease, may increase in prevalence and distribution due to changes in season duration, rainfall, and rising temperatures.(5,53–55) For people living with HIV who may be immunocompromised, such infectious diseases could become more harmful and contribute to poorer HIV outcomes. (56–58) Infrastructure erosion can also compromise healthcare access. Extreme weather events may disrupt HIV testing and prevention access such as in post-cyclone,(59) hurricane (60) and earthquake settings.(61) Food insecurity, as described earlier, has complex links with HIV acquisition risks and is exacerbated among persons living with HIV.(21,62)

In another recent framework, Women Deliver conceptualized paths from climate change to sexual and reproductive health outcomes, including disruptions in access to health services, as described above, as well as increased exposure to sexual and gender based violence (SGBV).(6) Extreme weather events such as drought and flooding have been linked with SGBV.(63) For instance, drought is associated with physical and sexual violence in 19 Sub-Saharan African countries—effects are exacerbated for adolescent girls.(63) Conflict arising when women have insufficient water to complete household tasks can contribute to intimate partner violence (IPV),(41,64) and women may also be at greater risk for non-partner violence while collecting water.(65) Food insecurity is also linked with IPV.(66,67) In addition to sexual violence's direct HIV risks,(68) SGBV increases HIV acquisition risks via trauma-related sequelae,(69) such as lower condom efficacy and coping-related substance use.(70,71)

These conceptual frameworks signal the urgent need to understand and address climate change and its impacts on sexual health, which is a core component of overall health and wellbeing.(72,73) Sexual health is multifaceted, described by the The World Health Organization (WHO) as:

A state of physical, emotional, mental and social well-being in relation to sexuality; it is not merely the absence of disease, dysfunction or infirmity. Sexual health requires a positive and

respectful approach to sexuality and sexual relationships, as well as the possibility of having pleasurable and safe sexual experiences, free of coercion, discrimination and violence. (p.3)(72)

Four components of sexual health conceptualized by the WHO include: comprehensive sexuality education and information; SGBV prevention, support, and care; preventing and controlling HIV infection and other STIs; and addressing sexual function and psychosexual counselling.(72,73) There appears to be a dearth of scoping reviews that systematically map the evidence on climate change and related processes, and sexual health outcomes, as conceptualized by the WHO.(72,73)

Scoping review approaches hold particular relevance in the field of climate change and health—including providing an overview of evidence, assessing types of evidence, exploring how key concepts are defined and conceptualized in the literature, and identifying knowledge gaps.(74,75) We identified three relevant scoping reviews on climate change and sexual health, yet none apply both a comprehensive definition of climate change and sexual health for persons of all genders. First, Thurston et al. (2021) examined natural hazards, disasters, and violence against women and girls in a mixed-methods systematic review.(76) This review found that natural disasters, caused by climatological, geophysical, hydrological, and meteorological hazards, were associated with violence against women and girls in diverse contexts.(76) While climate change was included as a hazard, the other dimensions of sexual health beyond SGBV were not included and the review was limited to women and girls. Second, Fatema et al. published a systematic review protocol on women’s health-related vulnerabilities in natural disasters focused on physical and psychological health and sexual harassment (77). While of importance, this was also limited to women and girls and did not have a focus on the full spectrum of sexual health outcomes. Third, a recent narrative synthesis by Loewen et al. examined natural disasters and disease epidemics (e.g. Ebola) and related sexual and reproductive health outcomes in low- and middle-income countries (LMIC).(78) This review only included studies with a health outcome focus on contraception and/or abortion services;(78) while sexual and reproductive health are interconnected, the WHO differentiates reproductive health (abortion care, contraception), which was measured in Loewen et al.’s review, from sexual health (e.g. HIV and STI).(72,73) The review focused on acute disruptions, excluding protracted crises such as drought. Loewen et al. included 13 studies in the review, and the Sub-Saharan Africa studies (n=8) focused on Ebola outbreaks while the other studies in Asia and the Caribbean examined natural disasters (earthquake, flood).(78) Loewen et al found that structural damages to health systems resulted in access barriers; they additionally found an overall decrease in contraception (including male condom) and family planning use in the midst of, and directly following, disruptive events.(78)

Our scoping review will build on these prior reviews to address knowledge gaps in how the wide ranging effects of climate change, both acute and protracted, affect the range of sexual health outcomes among all genders and global contexts. Specifically, it will address the following research question: *what is known in the literature about the associations between climate change and sexual health?*

Methods

This scoping review explores the linkages between climate change and sexual health using the framework developed by Arksey and O'Malley (79) and further developed by the Joanna Briggs Institute.(75,80) The reporting for this review will also follow the guidelines outlined in the Preferred Reporting Items for Systematic Review and Meta-Analysis extension for scoping reviews (PRISMA-ScR).(81,82)

Defining Sexual Health

The search strategy and eligibility criteria pertaining to sexual health were informed by the WHO's framework for operationalizing sexual health.(72,73) The WHO identifies sexual and reproductive health as distinct but interrelated concepts. While sexual health may encompass a person's fertility capacity and status, it also includes periods in advance of and following a person's reproductive years.(73) As such, we focus this review on the four sexual health intervention areas from the WHO framework(72,73): (1) comprehensive sexuality education and information (including information on sexuality and reproduction, empowerment and skills for enacting informed choices regarding sexuality and sexual health); (2) SGBV experiences and access to prevention, support and care (this includes violence targeting any gender, including sexual and gender minorities; and physical, sexual and/or emotional violence); (3) preventing and controlling HIV infection and other STIs (this includes oral, anal, and vaginal transmission; STIs including gonorrhea, syphilis, HIV, chlamydia, and herpes simplex virus; and access to testing, prevention and treatment); and (4) sexual function and psychosexual counselling (including addressing psychological, physical, physiological, and interpersonal factors associated with sexual concerns and sexual satisfaction).(72,73) The search strategy specifically includes search terms related to HIV in addition to those related to STIs more broadly, as is outlined in the framework.

Defining Climate Change: Extreme Weather Events

The search strategy and eligibility criteria pertaining to climate change were informed by the field of planetary health (4) and the work of Bell and colleagues on extreme weather events.(3) Though there is no single definition of an extreme weather event, researchers within the field of climate change have suggested that this can be broadly defined as "climate-related events that rarely occur at a given location or have significant socioeconomic impacts." (3) We will follow examples provided by Bell and colleagues who identify droughts, heat waves, wildfires, dust storms, hurricanes, flooding rains, coastal flooding, and storm surges as comprising extreme weather events, specifically due to their identified linkages to climate change.(3) We will also include climate change-induced earthquakes (83–85), landslides (86) and volcanos.(87)

Search Strategy

In consultation with a University of Toronto librarian, electronic databases were assessed for their relevance and potential coverage of the topic. After careful review, four databases were selected for the search, MEDLINE, EMBASE, PsycINFO, CINAHL, and these will be searched for relevant articles using a search strategy including text words and subject headings (e.g., MeSH, Emtree) related to sexual health and climate change, as defined above, since the

inception of each database. For a complete search strategy, please see Appendix I. Searches will not be limited by language, year of publication, or geographic location. Records returned from this search will be managed in Mendeley and Covidence.(88) A manual search of the reference lists of included studies will be conducted to identify additional literature that might not have been captured in our original search. In addition, the research team will supplement the database searches with grey literature using a comprehensive search guide originally developed by Godin and colleagues (89) and adapted by librarians at both the University of Waterloo and the University of Toronto.(90) The sources of unpublished reports and grey literature will include, for example, the WHO, the World Bank eLibrary, and the Centers for Disease Control and Prevention website.

Study Selection

Title & abstract screen

The screening process will be compatible with the PRISMA-ScR standards recommended for peer-reviewed publications.(81,82) Articles will not be assessed for quality as is practiced in systematic reviews, as this is typically not done in scoping reviews;(75,81) and the purpose of this scoping review is to synthesize and identify themes within the available and included literature. Following the removal of duplicates, two reviewers (reviewers include ACR, DT and KM) will independently assess all identified titles and abstracts for eligibility. Quantitative, qualitative, mixed-methods, and review articles will be considered for inclusion. To be included in the full text review, articles must discuss some facet of sexual health (including sex education, sexual health counselling, sexually transmitted infections) and/or SGBV (including sexual, physical and emotional violence, domestic and intimate partner violence, rape) in the context of climate change and/or extreme weather event. Articles will be excluded if their primary populations of interest are infants or children (aged <10 years old) or if they explore sexual health or SGBV separately from climate change or extreme weather events. Additionally, conference abstracts, protocols, dissertations, books or book reviews, and studies conducted in animals as well as studies for which full text articles are not available will be excluded. Reviewers will review a random sample of articles to confirm a common interpretation of the above criteria. Covidence software (88) will be used for screening and to monitor agreement between the two reviewers' assessments. Any differences will be resolved through discussion and consensus, if consensus cannot be reached, articles will be moved to the full-text screen for further review.

Full text screen

The full text screen will be completed independently by two reviewers (ACR, DT, and/or KM) using the same criteria outlined above. As with the title and abstract screen, Covidence software will be used to conduct the screening and monitor agreement between the reviewers' assessments. All differences in screening will be resolved through discussion and consensus of the two reviewers, or in consultation with a third reviewer if needed. The reference lists of articles meeting the criteria for full-text review will be manually searched for additional articles relevant to the review.

Data Charting and Synthesis

The following data will be extracted from all included studies: study details (i.e., location, duration, design, population, sample size, data source, type of extreme weather event, type of sexual health outcome) and key findings (i.e., impact of extreme weather event on sexual health, duration of impact, implications). Data extraction will be completed by one reviewer (ACR, DT, and/or KM) and peer reviewed by a second second (ACR, DT, and/or KM). Data synthesis will involve analyzing the findings from identified studies using thematic analysis approaches.(91,92) Studies will be grouped into the four domains of sexual health described above (comprehensive sexuality education, SGBV, HIV and STI, and psychosexual counselling), and we will apply sex and gender-based analyses (93) to explore sex/gender differences in findings as well as inclusion in studies, alongside discussion of gender norms and their linkage to sexual health. Where relevant, we will also identify intersectional identities (94) and the socio-demographic characteristics documented in studies (including but not limited to gender, age, sexual orientation and gender identity, refugee status, income, parenthood status, LMIC, sex work), and how those are included in studies and any linkages to climate change and/or sexual health impacts. We will aggregate themes to synthesize overall findings to present, as well as disaggregate findings by gender, type of climate change/extreme weather event (e.g., drought vs. flood), and by LMIC vs. high income country. We will also examine similarities and differences between LMIC, for instance, between Sub-Saharan African and Caribbean contexts. Data will be presented both in narrative and tabular forms.

Ethics & Dissemination

As this review involves a synthesis and presentation of available resources, it does not require ethics approval. Results will be published in a peer-reviewed journal, developed in to easily disseminated infographics, and shared at national and international conferences.

Patient and Public Involvement

As this is a scoping review there is no original data collection, hence there were no patient and public involvement in this research. However the scoping review team includes gender, age, ethno-racial, sexual orientation and career stage diversity, and includes persons working on sexual health research in South and South-East Asia, Sub-Saharan Africa, and the Caribbean.

Discussion

This study is unique in looking at climate change, and its acute and protracted effects, and impacts on a range of comprehensive sexual health outcomes among diverse populations. This review will provide a thematic overview of the literature on global impacts of climate change on sexual health, offering new insight into the types of sexual health outcomes that have been assessed, sex and gender-based analyses,(93) and contexts that have been included or overlooked in climate change and sexual health literature. Thus, by methodologically mapping the existing evidence, this scoping review will identify knowledge gaps, and both research and policy priorities in this area. For instance, this review could support existing sexual health programs and organizations to reconcile with the mounting impacts of climate change. By doing so, programs

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can be better prepared to adapt to the changing climate and respond to extreme weather events and other environmental disasters. We will also produce regional specific findings, both between LMIC and high income contexts, and within LMIC, to inform recommendations for practice, policy and future research. Moreover, the review will identify potential gaps and disparities in the existing literature to support policy makers and researchers to develop research questions and interventions to improve the delivery of sexual health services in a changing climate.

Current study status

The search strategy was developed in collaboration with a University of Toronto librarian, has been translated for each of the four databases. All four database searches have been run and title/abstract screening is underway.

Contributors: CHL conceptualized the study and was responsible for drafting protocol. ACR and DT substantially contributed to drafting protocol and led writing of the methods. They developed and refined the search strategy in collaboration with the librarian, and significantly contributed to inclusion/exclusion criteria, methods, and tools. ACR, DT and KM refined the inclusion/exclusion criteria. All authors read, revised and approved the final manuscript.

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Competing interests: None declared.

Patient consent for publication: Not required

Ethics approval: This study assesses data that is from published studies and does not involve human participants, thus is exempt from ethics approval.

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- reviews, a type of knowledge synthesis, follow a systematic approach to map evidence on a topic and identify main concepts, theories, sources, and knowledge gaps. Although more scoping reviews, a type of knowledge synthesis, follow a systematic approach to map evidence on a topic and identify main concepts, theories, sources, and knowledge gaps. Although more
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Appendix I: Search Strategy Sexual Health x Planetary Health

MEDLINE – Search

1. Domestic Violence/ or (domestic adj3 (abus* or violen*)).tw,kf.
2. exp Intimate Partner Violence/ or ((partner* or spous* or wife or wives) adj3 (abus* or violen*)).tw,kf.
3. Gender-Based Violence/ or (gender-based violence).tw,kf.
4. Sex work/ or (sex work).tw,kf. or (sex adj3 industr*).tw,kf. or (prostitut*).tw,kf. or (sex* adj1 transact*).tw,kf.
5. Rape/ or rape.tw,kf.
6. Sex Offenses/ or Sexual Health/ or Sex Education/ or Sex Counseling/ or (sex* adj3 (abus* or offen* or health or educat* or counsel*)).tw,kf. or (family planning).tw,kf.
7. exp Sexually Transmitted Diseases/ or ((sexually transmitted or venereal) adj3 (diseas* or infect*)).tw,kf. or (sti or stis).tw,kf. or (std or stds).tw,kf.
8. exp HIV Infections/ or (HIV adj3 infect*).tw,kf.
9. exp Syphilis/ or syphilis.tw,kf.
10. exp Chlamydia/ or exp Chlamydia Infections/ or chlamydia.tw,kf.
11. Gonorrhea/ or gonorrhea.tw,kf.
12. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11
13. exp Natural Disasters/ or ((natural adj3 disaster*) or drought* or wildfire or (flood* adj3 (rain* or coast*)) or (storm surge) or (dust storm) or hurricane* or (tropical storm*)).tw,kf.
14. exp Extreme Weather/ or (heat wave* or extreme weather).tw,kf.
15. exp Climate Change/ or ((climate adj1 chang*) or (sea level* adj1 (rise* or rising))) .tw,kf.
16. 13 or 14 or 15
17. 12 and 16

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Exploring linkages between climate change and sexual health: A scoping review protocol

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Abstract

Introduction

The effects of climate change and associated extreme weather events (EWE) present substantial threats to wellbeing. Extreme weather events hold the potential to harm sexual health through pathways including elevated exposure to HIV and other sexually transmitted infections (STI), disrupted health care access, and increased sexual and gender-based violence (SGBV). The World Health Organization (WHO) defines four components of sexual health: comprehensive sexuality education; HIV and STI prevention and care; SGBV prevention and care; and psychosexual counselling. Yet knowledge gaps remain regarding climate change and its associations with these sexual health domains. This scoping review will therefore explore the linkages between climate change and sexual health.

Methods and analysis

Four electronic databases (MEDLINE, EMBASE, PsycINFO, Web of Science, CINAHL) will be searched using text words and subject headings (e.g., MeSH, Emtree) related to sexual health and climate change from the inception of each database to May 2021. Grey literature and unpublished reports will be searched using a comprehensive search strategy, including from the WHO, World Bank eLibrary, and the Centers for Disease Control and Prevention. The scoping review will consider studies that explore: a) climate change and EWE including droughts, heat waves, wildfires, dust storms, hurricanes, flooding rains, coastal flooding, and storm surges; alongside b) sexual health, including: comprehensive sexual health education, sexual health counselling, and HIV/STI acquisition, prevention and/or care, and/or SGBV, including intimate partner violence, sexual assault and rape. Searches will not be limited by language, publication year, or geographic location. We will consider quantitative, qualitative, mixed-methods, and review articles for inclusion. We will conduct thematic analysis of findings. Data will be presented in narrative and tabular forms.

Ethics and dissemination

There are no formal ethics requirements as we are not collecting primary data. Results will be published in a peer-reviewed journal and shared at international conferences.

Keywords: HIV & AIDS, public health, tropical medicine, climate change, sexual health,

Strengths and limitations of this study

- This scoping review will offer an innovative and comprehensive approach to climate change and associations with multiple sexual health domains, including sexual education, HIV/STI prevention and treatment
- At both screening stages, reviewers will first assess a random selection of articles to establish and document a common understanding of the nuances of the inclusion/exclusion criteria; a process that will be documented and included in the publishing of the results.
- No limitations on date, location, or language are incorporated into the search strategy to maximize the ability to find all relevant peer reviewed literature in the included databases.
- The comprehensive database search will be bolstered by a grey literature search of major global organizations likely to have reported on this intersection.
- As terminology for climate change and extreme weather events is evolving and connected to the larger planetary health field, newly emerging terms may not be included in our search.
- The four databases identified and searched for this review were chosen based on their relevance and potential coverage of the topics of interest; however, peer reviewed literature that is not captured by these databases may be missed. To address this, we will manually search the reference lists of included articles for any additional articles relevant to the review.
- We acknowledge that despite our best efforts to identify relevant global organizations reporting on this intersection and develop a comprehensive grey literature search, we may miss relevant documentation.

BACKGROUND

Climate change is one of the greatest threats to health and wellbeing in the 21st century.(1,2) Warming temperatures, heat extremes, floods, droughts, wildfires, increased frequency of intense storms, and other extreme weather events are linked to climate change, and have impacts on human health and wellbeing.(3) Direct and indirect health effects of extreme weather events include malnutrition, poverty, poor mental health, non-communicable diseases, and infectious diseases.(4) An emerging literature signals the importance of attending to the linkages between climate change and sexual health outcomes.(5,6) HIV is an illustrative example, with prevalence highest in Sub-Saharan Africa, a region that is highly impacted by climate change and associated extreme weather events such as drought,(1,7–9) as well as Caribbean contexts such as Haiti. (10–12)

Climate change impacts broader environmental systems to increase strain on global food and water supplies.(2,13,14) Drought can increase food insecurity,(15–17) migration,(18–20) and disrupt both provision of—and access to—health services.(13) Food insecurity is associated with HIV acquisition risks through behavioural (e.g. transactional sex) and mental health (e.g., alcohol use, depression) pathways.(21,22) Food insecurity has also been associated with increased sexual risk practices among HIV-positive youth in Sub-Saharan Africa(23) and increased transactional sex and reduced safer sex efficacy among HIV-positive women.(24) It has also been linked with reduced condom efficacy among adolescents(25) and reduced condom use with adults.(26) Drought is also linked with HIV vulnerabilities, largely through reduced income.(9) Water insecurity and linkages with HIV acquisition and other sexual health outcomes are understudied,(27) as is the nexus of climate change, food and water insecurity, and sexual health outcomes.(5)

Both HIV and other sexually transmitted infections (STIs), as well as climate change and extreme weather events, disproportionately affect marginalized persons, including adolescent girls and young women, migrants, sexually and gender diverse persons, and persons living in poverty.(6,28–33) For instance, Burke et al. found that in a study of 2000 people across 19 Sub-Saharan African countries, a rainfall shock (annual rain less than the 15th percentile of the local area’s historical rainfall distribution) was associated with an 11% increase in HIV prevalence among rural populations that had a high HIV prevalence at baseline.(9) In another study in Lesotho, a drought in the past two years was linked with higher HIV prevalence among adolescent girls in rural areas, but not among boys.(8) Baker modelled the effects of climate change using datasets including 400,000 persons across 25 Sub-Saharan African countries, specifically examining impacts of long-term temperature increases on HIV prevalence.(34) Warmer time periods were associated with increased HIV prevalence, and this increase was higher in rural regions and with younger age groups, and may be linked with men’s migration and engagement in transactional sex.(34) The effects of climate change are often unequal and disproportionately impact populations who have contributed the least to the crisis.(2,35,36) The 2020 Lancet Countdown report indicates that climate change and its contribution to extreme weather events and rising sea levels will increase human migration and displacement, both of which pose risks to human health,(2) including sexual health.(37,38)

An ecosocial theoretical approach considers how hazardous environments, poverty, and social inequities are embodied.(39) The resource scarcity framework conceptualizes shared structural drivers as social (e.g. gender norms), economic (e.g. poverty), and ecologic (e.g. climate change) factors that contribute to water and food insecurity and ultimately to wellbeing.(40,41) Several conceptual frameworks have linked ecosocial factors to HIV and STI vulnerabilities and other sexual health concerns. Tallman et al. applied the ecosyndemic approach to understand the ways through which building dams and highways in tropical forests in Brazil and Peru was linked with vector-borne infections, sex work, and increased STIs.(42) The ecosyndemics framework examines the ways in which largely human-caused environmental changes interact with economic and social inequities to harm health.(43–45) Mapping ecosyndemic risk hotspots and community engagement can provide insight into how social and ecological system changes interact to shape STI and other health concerns.

Lieber et al. conceptualized four paths from climate change to HIV and AIDS, including increased migration, infectious diseases, infrastructure erosion, and food insecurity.(5) For instance, extreme weather events such as drought and flooding have been linked with elevated sexual risk practices including condomless and transactional sex (8,46) and early sexual debut.(9) Extreme weather events may also result in long and short-term migration (47–50) that is associated with increased sexual networks and sexual exploitation.(51,52) Infectious diseases, such as malaria, dengue, chikungunya, and Lyme disease, may increase in prevalence and distribution due to changes in season duration, rainfall, and rising temperatures.(5,53–55) For people living with HIV, who may be immunocompromised, such infectious diseases could become more harmful and contribute to poorer HIV outcomes. (56–58) Infrastructure erosion can also compromise healthcare access. Extreme weather events may disrupt HIV testing and prevention access such as in post-cyclone,(59) hurricane (60) and earthquake settings.(61) Food insecurity, as described earlier, has complex links with HIV acquisition risks and is exacerbated among persons living with HIV.(21,62)

In another recent framework, Women Deliver conceptualized paths from climate change to sexual and reproductive health outcomes, including disruptions in access to health services, as described above, as well as increased exposure to sexual and gender based violence (SGBV).(6) Extreme weather events such as drought and flooding have been linked with SGBV.(63) For instance, drought is associated with physical and sexual violence in 19 Sub-Saharan African countries—effects are exacerbated for adolescent girls.(63) Conflict arising when women have insufficient water to complete household tasks can contribute to intimate partner violence (IPV),(41,64) and women may also be at greater risk for non-partner violence while collecting water.(65) Food insecurity is also linked with IPV.(66,67) In addition to sexual violence's direct HIV risks,(68) SGBV increases HIV acquisition risks via trauma-related sequelae,(69) such as lower condom efficacy and coping-related substance use.(70,71)

These conceptual frameworks signal the urgent need to understand and address climate change and its impacts on sexual health, which is a core component of overall health and wellbeing.(72,73) Sexual health is multifaceted, described by The World Health Organization (WHO) as:

A state of physical, emotional, mental and social well-being in relation to sexuality; it is not merely the absence of disease, dysfunction or infirmity. Sexual health requires a positive and

respectful approach to sexuality and sexual relationships, as well as the possibility of having pleasurable and safe sexual experiences, free of coercion, discrimination and violence. (p.3)(72)

Four components of sexual health conceptualized by the WHO include: comprehensive sexuality education and information; SGBV prevention, support, and care; preventing and controlling HIV infection and other STIs; and addressing sexual function and psychosexual counselling.(72,73) There appears to be a dearth of scoping reviews that systematically map the evidence on climate change and related processes, and sexual health outcomes, as conceptualized by the WHO.(72,73)

Scoping review approaches hold particular relevance in the field of climate change and health—including providing an overview of evidence, assessing types of evidence, exploring how key concepts are defined and conceptualized in the literature, and identifying knowledge gaps.(74,75) We identified three relevant scoping reviews on climate change and sexual health, yet none apply both a comprehensive definition of climate change and sexual health for persons of all genders. First, Thurston et al. (2021) examined natural hazards, disasters, and violence against women and girls in a mixed-methods systematic review.(76) This review found that natural disasters—caused by climatological, geophysical, hydrological, and meteorological hazards—were associated with violence against women and girls in diverse contexts.(76) While Thurston et al. included climate change as a hazard, the other dimensions of sexual health beyond SGBV were not included, and their review was limited to women and girls. Second, Fatema et al. published a systematic review protocol on women’s health-related vulnerabilities in natural disasters, which focused on physical and psychological health and sexual harassment (77). While of importance, this review was also limited to women and girls and did not focus on the full spectrum of sexual health outcomes. Third, a recent narrative synthesis by Loewen et al. examined natural disasters and disease epidemics (e.g. Ebola) and related sexual and reproductive health outcomes in low- and middle-income countries (LMIC).(78) This review only included studies with a health outcome focus on contraception and/or abortion services;(78) while sexual and reproductive health are interconnected, the WHO differentiates reproductive health (abortion care, contraception), which was measured in Loewen et al.’s review, from sexual health (e.g. HIV and STI).(72,73) The review focused on acute disruptions, excluding protracted crises such as drought. Loewen et al. included 13 studies in the review, and the Sub-Saharan Africa studies (n=8) focused on Ebola outbreaks while the other studies in Asia and the Caribbean examined natural disasters (earthquake, flood).(78) Loewen et al found that structural damages to health systems resulted in access barriers; they additionally found an overall decrease in contraception (including male condom use) and family planning use in the midst of, and directly following, disruptive events.(78)

Our scoping review will build on these prior reviews to address knowledge gaps in how the wide-ranging effects of climate change, both acute and protracted, affect the range of sexual health outcomes among all genders and global contexts. Specifically, it will address the following research question: *what is known in the literature about the associations between climate change and sexual health?*

METHODS AND ANALYSIS

This scoping review explores the linkages between climate change and sexual health using the framework developed by Arksey and O'Malley (79) and further developed by the Joanna Briggs Institute.(75,80) The reporting for this review will also follow the guidelines outlined in the Preferred Reporting Items for Systematic Review and Meta-Analysis extension for scoping reviews (PRISMA-ScR).(81,82)

Defining sexual health

The search strategy and eligibility criteria pertaining to sexual health were informed by the WHO's framework for operationalizing sexual health.(72,73) The WHO identifies sexual and reproductive health as distinct but interrelated concepts. While sexual health may encompass a person's fertility capacity and status, it also includes periods in advance of and following a person's reproductive years.(73) As such, we focus this review on the four sexual health intervention areas from the WHO framework(72,73): (1) comprehensive sexuality education and information (including information on sexuality and reproduction, and empowerment and skills for enacting informed choices regarding sexuality and sexual health); (2) SGBV experiences and access to prevention, support and care (this includes violence targeting any gender, including sexual and gender minorities; and physical, sexual and/or emotional violence); (3) preventing and controlling HIV infection and other STIs (this includes oral, anal, and vaginal transmission; STIs including gonorrhea, syphilis, HIV, chlamydia, and herpes simplex virus; and access to testing, prevention and treatment); and (4) sexual function and psychosexual counselling (including addressing psychological, physical, physiological, and interpersonal factors associated with sexual concerns and sexual satisfaction).(72,73) The search strategy specifically includes search terms related to HIV in addition to those related to STIs more broadly, as is outlined in the framework.

Defining climate change: extreme weather events

The search strategy and eligibility criteria pertaining to climate change were informed by the field of planetary health (4) and the work of Bell and colleagues on extreme weather events.(3) Though there is no single definition of an extreme weather event, researchers within the field of climate change have suggested that this can be broadly defined as "climate-related events that rarely occur at a given location or have significant socioeconomic impacts." (3) We will follow examples provided by Bell and colleagues who identify droughts, heat waves, wildfires, dust storms, hurricanes, flooding rains, coastal flooding, and storm surges as comprising extreme weather events, specifically due to their identified linkages to climate change.(3)

Search strategy

In consultation with a University of Toronto librarian, electronic databases were assessed for their relevance and potential coverage of the topic. After careful review, five databases were selected for the search, MEDLINE, EMBASE, PsycINFO, CINAHL, and Web of Science. These will be searched for relevant articles using a search strategy including text words and subject headings (e.g., MeSH, Emtree) related to sexual health and climate change, as defined above, from the inception of each database to May 2021. These terms include:

- sexual health (including sex education, sexual health counselling, sexually transmitted infections, HIV/AIDS); OR
- sex- and gender-based violence (including sexual, physical, and emotional violence, domestic and intimate partner violence, rape); AND
- climate change, extreme weather events, natural disasters (specifically, droughts, heat waves, wildfires, dust storms, hurricanes, flooding rains, coastal flooding, and storm surges)

For a complete search strategy, please see **Appendix I**. Searches will not be limited by language, year of publication, or geographic location. Records returned from this search will be managed in EndNote and Covidence.⁽⁸³⁾ A manual search of the reference lists of included studies will be conducted to identify additional literature that might not have been captured in our original search. In addition, the research team will supplement the database searches with grey literature following a comprehensive search guide developed by Godin and colleagues ⁽⁸⁴⁾ and adapted by librarians at both the University of Waterloo and the University of Toronto.⁽⁸⁵⁾ Informed by this guide, the following relevant authorities were identified and their websites will be searched for unpublished reports and grey literature: the WHO, the World Bank eLibrary, the Centers for Disease Control and Prevention, Women Deliver, the International Planned Parenthood Association, the NAP Global Network, the Asian-Pacific Resource and Research Centre for Women, and The United Nations. As with the database search, the grey literature search will not be limited by language, year of publication, or geographic location. Reference lists from identified reports will also be reviewed to identify any additional reports that may not have been captured through the initial search.

Study selection

Title & abstract screen

The screening process will be compatible with the PRISMA-ScR standards recommended for peer-reviewed publications.^(81,82) Articles will not be assessed for quality as is practiced in systematic reviews, as this is not typically done in scoping reviews;^(75,81) and the purpose of this scoping review is to synthesize and identify themes within the available and included literature. Following the removal of duplicates, two reviewers (reviewers include ACR, DT and KM) will independently assess all identified titles and abstracts for eligibility. Quantitative, qualitative, mixed-methods, and review articles will be considered for inclusion. To be included in the full text review, articles must discuss some facet of sexual health (including sex education, sexual health counselling, sexually transmitted infections) and/or SGBV (including sexual, physical and emotional violence, domestic and intimate partner violence, rape) in the context of climate change and/or extreme weather events. Articles will be excluded if their primary populations of interest are infants or children (aged <10 years old) or if they explore sexual health or SGBV separately from climate change or extreme weather events. Additionally, conference abstracts, protocols, books or book reviews, studies conducted in animals, as well as studies for which full text articles are not available, will be excluded. Reviewers will review a random sample of articles to confirm a common interpretation of the above criteria. Covidence software ⁽⁸³⁾ will be used for screening and to monitor agreement between the two reviewers’

assessments. Any differences will be resolved through discussion and consensus, if consensus cannot be reached, articles will be moved to the full-text screen for further review.

Full text screen

The full text screen will be completed independently by two reviewers (ACR, DT, and/or KM) using the same criteria outlined above. As with the title and abstract screen, Covidence software will be used to conduct the screening and monitor agreement between the reviewers' assessments. All differences in screening will be resolved through discussion and consensus of the two reviewers, or in consultation with a third reviewer if needed. The reference lists of articles meeting the criteria for full-text review will be manually searched for additional articles relevant to the review.

Data charting and synthesis

The following data will be extracted from all included studies: study details (i.e., location, duration, design, population, sample size, data source, type of extreme weather event, type of sexual health outcome) and key findings (i.e., impact of extreme weather event on sexual health, duration of impact, implications). Data extraction will be completed by one reviewer (ACR, DT, and/or KM) and peer reviewed by a second (ACR, DT, and/or KM). Data synthesis will involve analyzing the findings from identified studies using thematic analysis approaches.^(86,87) Studies will be grouped into the four domains of sexual health described above (comprehensive sexuality education, SGBV, HIV and STI, and psychosexual counselling). We will apply sex and gender-based analyses⁽⁸⁸⁾ to explore sex/gender differences in findings as well as integration of sex and gender factors in included studies; this will inform a discussion of gender norms and their linkage to climate change, extreme weather events, and sexual health. Where relevant, we will also identify intersectional identities⁽⁸⁹⁾ and the socio-demographic characteristics documented in studies (including but not limited to gender, age, sexual orientation and gender identity, refugee status, income, parenthood status, LMIC, sex work), and how those are included in studies and any linkages to climate change and/or sexual health impacts. We will aggregate themes to synthesize overall findings, as well as disaggregate findings by gender, type of climate change/extreme weather event (e.g., drought vs. flood), and by LMIC vs. high-income country. We will also examine similarities and differences between LMIC, for instance, between Sub-Saharan African and Caribbean contexts. Data will be presented both in narrative and tabular forms.

Patient and public involvement

There will be no patient or public involvement in this research.

ETHICS AND DISSEMINATION

As this review involves a synthesis and presentation of available resources, it does not require ethics approval. Results will be published in a peer-reviewed journal, developed into easily disseminated infographics, and shared at international conferences.

DISCUSSION

This review is unique in looking at the impacts of climate change on a range of comprehensive sexual health outcomes among diverse populations. This review will provide a thematic overview of the literature on the global impacts of climate change on sexual health, offering new insight into the types of sexual health outcomes that have been assessed, sex and gender-based analyses,(88) and contexts that have been included or overlooked in climate change and sexual health literature. Thus, by mapping the existing evidence, this scoping review will identify knowledge gaps and research and policy priorities. For instance, this review could support existing sexual health programs and organizations to address the impacts of climate change. By doing so, programs can be better prepared to adapt to climate change, extreme weather events, and other environmental disasters. Based on available findings, we also aim to produce regional specific findings, both between LMIC and high-income contexts and within LMIC, to inform recommendations for practice, policy, and research. Moreover, the review will identify potential gaps in the existing literature to support policy makers and researchers to develop research questions and interventions to improve the delivery of sexual health services in the context of a changing climate.

There are several limitations to this review. The terminology around climate change and extreme weather events, the key concepts in this review, is continuously evolving. It is likely that newly emerging terms are not encompassed in our search strategy, which may result in relevant literature being missed. Furthermore, though we selected the four searched databases based on their relevance and coverage of the topics of interest, there may be peer reviewed articles not indexed by these databases that are missed by our search. To combat this, we will manually search the reference lists of included articles to identify any additional literature relevant to our review. Finally, though the inclusion of a grey literature search is a strength of this review, we acknowledge that grey literature searches are imperfect and relevant documentation may be missed.

Current study status

The search strategy was developed in collaboration with a University of Toronto librarian, has been translated for each of the four databases. All four database searches have been run and title/abstract screening has been completed. Full text screening is now underway.

Contributors: CHL conceptualized the study and was responsible for drafting protocol. ACR and DT substantially contributed to drafting protocol and led writing of the methods. They developed and refined the search strategy in collaboration with the librarian, and significantly contributed to inclusion/exclusion criteria, methods, and tools. ACR, DT and KM refined the inclusion/exclusion criteria. PAN was a grant co-applicant and provided manuscript feedback. SW, OH, IB, and AA provided manuscript feedback and edits. All authors read, revised and approved the final manuscript.

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- reviews, a type of knowledge synthesis, follow a systematic approach to map evidence on a topic and identify main concepts, theories, sources, and knowledge gaps. Although more scoping reviews, a type of knowledge synthesis, follow a systematic approach to map evidence on a topic and identify main concepts, theories, sources, and knowledge gaps. Although more
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Appendix I: Search Strategy - Sexual Health x Planetary Health

MEDLINE – Search run May 13, 558 articles identified

- 1. Domestic Violence/ or (domestic adj3 (abus* or violen*)).tw,kf.
- 2. exp Intimate Partner Violence/ or ((partner* or spous* or wife or wives) adj3 (abus* or violen*)).tw,kf.
- 3. Gender-Based Violence/ or (gender-based violence).tw,kf.
- 4. Sex work/ or (sex work).tw,kf. or (sex adj3 industr*).tw,kf. or (prostitut*).tw,kf. or (sex* adj1 transact*).tw,kf.
- 5. Rape/ or rape.tw,kf.
- 6. Sex Offenses/ or Sexual Health/ or Sex Education/ or Sex Counseling/ or (sex* adj3 (abus* or offen* or health or educat* or counsel*)).tw,kf. or (family planning).tw,kf.
- 7. exp Sexually Transmitted Diseases/ or ((sexually transmitted or venereal) adj3 (diseas* or infect*)).tw,kf. or (sti or stis).tw,kf. or (std or stds).tw,kf.
- 8. exp HIV Infections/ or (HIV adj3 infect*).tw,kf.
- 9. exp Syphilis/ or syphilis.tw,kf.
- 10. exp Chlamydia/ or exp Chlamydia Infections/ or chlamydia.tw,kf.
- 11. Gonorrhea/ or gonorrhea.tw,kf.
- 12. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11
- 13. exp Natural Disasters/ or ((natural adj3 disaster*) or drought* or wildfire or (flood* adj3 (rain* or coast*)) or (storm surge) or (dust storm) or hurricane* or (tropical storm*)).tw,kf.
- 14. exp Extreme Weather/ or (heat wave* or extreme weather).tw,kf.
- 15. exp Climate Change/ or ((climate adj1 chang*) or (sea level* adj1 (rise* or rising))) .tw,kf.
- 16. 13 or 14 or 15
- 17. 12 and 16

EMBASE – Search run May 13, 1153 articles identified

- 1. domestic violence/ or (domestic adj3 (abus* or violen*)).tw,kw.
- 2. exp partner violence/ or ((partner* or spous* or wife or wives) adj3 (abus* or violen*)).tw,kw.
- 3. exp gender based violence/ or gender based violence.tw,kw.
- 4. prostitution/ or (sex work).tw,kw. or (sex adj3 industr*).tw,kw. or (prostitut*).tw,kw. or (sex* adj1 transact*).tw,kw.
- 5. rape/ or rape.tw,kw.
- 6. sexual crime/ or sexual health/ or sexual education/ or sexual counseling/ or (sex* adj3 (abus* or offen* or health or educat* or counsel*)).tw,kw. or (family planning).tw,kw.
- 7. exp sexually transmitted disease/ or ((sexually transmitted or venereal) adj3 (diseas* or infect*)).tw,kw. or (sti or stis).tw,kw. or (std or stds).tw,kw.
- 8. exp Human immunodeficiency virus infection/ or (HIV adj3 infect*).tw,kw.
- 9. exp Syphilis/ or syphilis.tw,kw.
- 10. exp Chlamydia/ or exp Chlamydia Infections/ or chlamydia.tw,kw.
- 11. Exp Gonorrhea/ or gonorrhea.tw,kw.
- 12. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11
- 13. natural disaster/ or (natural adj3 disaster*).tw,kw.

14. exp environmental impact/ or (drought* or wildfire or (flood* adj3 (rain* or coast*)) or (storm surge) or (dust storm) or hurricane* or (tropical storm*) or (sea level* adj1 (rise* or rising))).tw,kw.
15. exp extreme weather/ or (heat wave* or extreme weather).tw,kw.
16. exp climate change/ or (climate adj1 chang*).tw,kw.
17. 13 or 14 or 15 or 16
18. 12 and 17

PsycINFO - Search run May 13, 380 articles identified

1. domestic violence/ or (domestic adj3 (abus* or violen*)).tw
2. intimate partner violence/ or ((partner* or spous* or wife or wives) adj3 (abus* or violen*)).tw
3. gender based violence.tw
4. sex work/ or ((sex work) or (sex adj3 industr*) or (prostitut*) or (sex* adj1 transact*)).tw
5. rape/ or rape.tw.
6. sex offenses/ or sexual health/ or sex education/ or family planning/ or (sex* adj3 (abus* or offen* or health or educat* or counsel*)).tw or (family planning).tw
7. sexually transmitted diseases/ or ((sexually transmitted or venereal) adj3 (diseas* or infect*)).tw or (sti or stis).tw or (std or stds).tw
8. HIV/ or (HIV adj3 infect*).tw. or (Human immunodeficiency virus adj3 infect*).tw.
9. syphilis/ or syphilis.tw.
10. chlamydia.tw.
11. gonorrhea/ or gonorrhea.tw.
12. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11
13. natural disasters/ or ((natural adj3 disaster*) or drought* or wildfire or (flood* adj3 (rain* or coast*)) or (storm surge) or (dust storm) or hurricane* or (tropical storm*)).tw.
14. climate change/ or ((climate adj1 chang*) or (sea level* adj1 (rise* or rising))).tw. or (heat wave* or extreme weather).tw.
15. 13 or 14
16. 12 and 15

CINAHL Search run May 18, 313 articles identified

1. MH ("Domestic Violence") OR TI (domestic N3 (abus* or violen*)) OR AB (domestic N3 (abus* or violen*))
2. MH ("Intimate Partner Violence") OR TI ((partner* or spous* or wife or wives) N3 (abus* or violen*)) OR AB ((partner* or spous* or wife or wives) N3 (abus* or violen*))
3. MH ("Gender-Based Violence") OR TI (gender-based violence) OR AB (gender-based violence)
4. MH ("Sex work") OR TI (sex work OR (sex N3 industr*) OR (prostitut*) OR (sex* N1 transact*)) OR AB (sex work OR (sex N3 industr*) OR (prostitut*) OR (sex* N1 transact*))
5. MH ("Rape") OR TI (rape) OR AB (rape)
6. MH ("Sexual Health") OR MH ("Sex Education") OR MH ("Sexual Counseling") OR TI (sex* N3 (abus* or offen* or health or educat* or counsel*) OR TI (family planning) OR AB (sex* N3 (abus* or offen* or health or educat* or counsel*) OR AB (family planning))

- 7. MH (“Sexually Transmitted Diseases+”) OR TI ((sexually transmitted or venereal) N3 (diseas* or infect*)) OR TI (sti or stis or std or stds) AB ((sexually transmitted or venereal) N3 (diseas* or infect*)) OR AB (sti or stis or std or stds)
- 8. MH (“HIV Infections+”) OR TI (HIV N3 infect*) OR AB (HIV N3 infect*)
- 9. MH (“Syphilis+”) OR TI (syphilis) OR AB (syphilis)
- 10. MH (“Chlamydia+”) OR MH (“Chlamydia Infections+”) OR TI (chlamydia) OR AB (chlamydia)
- 11. MH (“Gonorrhea”) OR TI (gonorrhea) OR AB (gonorrhea)
- 12. S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11
- 13. MH (“Natural Disasters+”) OR TI ((natural N3 disaster*) OR drought* OR wildfire OR (flood* N3 (rain* OR coast*)) OR (storm surge) OR (dust storm) OR hurricane* OR (tropical storm*)) OR AB ((natural N3 disaster*) or drought* or wildfire or (flood* N3 (rain* or coast*)) or (storm surge) or (dust storm) or hurricane* or (tropical storm*))
- 14. MH (“Extreme Weather”) OR TI (heat wave* OR extreme weather) OR AB (heat wave* OR extreme weather)
- 15. MH (“Climate Change”) OR TI ((climate N1 chang*) OR (sea level* N1 (rise* OR rising))) OR AB ((climate N1 chang*) OR (sea level* N1 (rise* OR rising)))
- 16. S13 OR S14 OR S15
- 17. S12 AND S16

Web of Science – Search run Sept 20, 2021, 1,471 articles identified

- 1. TS=((domestic NEAR/2 (abus* OR violen*)) OR ((partner* OR spous* or wife or wives) NEAR/3 (abus* OR violen*)) OR (“gender-based violence”) OR (“sex work*”) OR (sex NEAR/2 industr*) OR (prostitut*) OR (sex* NEAR/1 transact*) OR (rape OR rapist*) OR (sex* NEAR/2 (abus* OR offen* OR health OR educat* OR counsel* OR violen*)) OR (“family planning”) OR ((“sexually transmitted” OR venereal) NEAR/2 (diseas* OR infect*)) OR (STI OR STD OR STIs OR STDs) OR (HIV NEAR/2 (infect* OR syphilis OR chlamydia OR gonorrhea)))
- 2. TS= (((natural NEAR/2 disaster*) or drought* or wildfire* or (flood* NEAR/2 (rain* or coast*)) or (“storm surge*”) or (“dust storm*”) or hurricane* or (“tropical storm*”)) OR (“heat wave*” or “extreme weather”) OR ((climate NEAR/1 chang*) or (“sea level*” NEAR/1 (rise* or rising))))
- 3. #1 AND #2

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Exploring linkages between climate change and sexual health: A scoping review protocol

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Abstract

Introduction

The effects of climate change and associated extreme weather events (EWE) present substantial threats to wellbeing. Extreme weather events hold the potential to harm sexual health through pathways including elevated exposure to HIV and other sexually transmitted infections (STI), disrupted health care access, and increased sexual and gender-based violence (SGBV). The World Health Organization (WHO) defines four components of sexual health: comprehensive sexuality education; HIV and STI prevention and care; SGBV prevention and care; and psychosexual counselling. Yet knowledge gaps remain regarding climate change and its associations with these sexual health domains. This scoping review will therefore explore the linkages between climate change and sexual health.

Methods and analysis

Five electronic databases (MEDLINE, EMBASE, PsycINFO, Web of Science, CINAHL) will be searched using text words and subject headings (e.g., MeSH, Emtree) related to sexual health and climate change from the inception of each database to May 2021. Grey literature and unpublished reports will be searched using a comprehensive search strategy, including from the WHO, World Bank eLibrary, and the Centers for Disease Control and Prevention. The scoping review will consider studies that explore: a) climate change and EWE including droughts, heat waves, wildfires, dust storms, hurricanes, flooding rains, coastal flooding, and storm surges; alongside b) sexual health, including: comprehensive sexual health education, sexual health counselling, and HIV/STI acquisition, prevention and/or care, and/or SGBV, including intimate partner violence, sexual assault and rape. Searches will not be limited by language, publication year, or geographic location. We will consider quantitative, qualitative, mixed-methods, and review articles for inclusion. We will conduct thematic analysis of findings. Data will be presented in narrative and tabular forms.

Ethics and dissemination

There are no formal ethics requirements as we are not collecting primary data. Results will be published in a peer-reviewed journal and shared at international conferences.

Keywords: HIV & AIDS, public health, tropical medicine, climate change, sexual health,

Strengths and limitations of this study

- This scoping review will offer an innovative and comprehensive approach to climate change and associations with multiple sexual health domains, including sexual education, HIV/STI prevention and treatment
- The search strategy includes five databases and grey literature with no limitations on date, location, or language to maximize the ability to find all relevant literature.
- As terminology for climate change and extreme weather events is evolving and connected to the larger planetary health field, newly emerging terms may not be included in our search.
- The five databases identified and searched for this review were chosen based on their relevance and potential coverage of the topics of interest; however, peer reviewed literature that is not captured by these databases may be missed.
- We acknowledge that despite our best efforts to identify relevant global organizations reporting on this intersection and develop a comprehensive grey literature search, we may miss relevant documentation.

BACKGROUND

Climate change is one of the greatest threats to health and wellbeing in the 21st century.(1,2) Warming temperatures, heat extremes, floods, droughts, wildfires, increased frequency of intense storms, and other extreme weather events are linked to climate change, and have impacts on human health and wellbeing.(3) Direct and indirect health effects of extreme weather events include malnutrition, poverty, poor mental health, non-communicable diseases, and infectious diseases.(4) An emerging literature signals the importance of attending to the linkages between climate change and sexual health outcomes.(5,6) HIV is an illustrative example, with prevalence highest in Sub-Saharan Africa, a region that is highly impacted by climate change and associated extreme weather events such as drought,(1,7–9) as well as Caribbean contexts such as Haiti. (10–12)

Climate change impacts broader environmental systems to increase strain on global food and water supplies.(2,13,14) Drought can increase food insecurity,(15–17) migration,(18–20) and disrupt both provision of—and access to—health services.(13) Food insecurity is associated with HIV acquisition risks through behavioural (e.g. transactional sex) and mental health (e.g., alcohol use, depression) pathways.(21,22) Food insecurity has also been associated with increased sexual risk practices among HIV-positive youth in Sub-Saharan Africa(23) and increased transactional sex and reduced safer sex efficacy among HIV-positive women.(24) It has also been linked with reduced condom efficacy among adolescents(25) and reduced condom use with adults.(26) Drought is also linked with HIV vulnerabilities, largely through reduced income.(9) Water insecurity and linkages with HIV acquisition and other sexual health outcomes are understudied,(27) as is the nexus of climate change, food and water insecurity, and sexual health outcomes.(5)

Both HIV and other sexually transmitted infections (STIs), as well as climate change and extreme weather events, disproportionately affect marginalized persons, including adolescent girls and young women, migrants, sexually and gender diverse persons, and persons living in poverty.(6,28–33) For instance, Burke et al. found that in a study of 2000 people across 19 Sub-Saharan African countries, a rainfall shock (annual rain less than the 15th percentile of the local area’s historical rainfall distribution) was associated with an 11% increase in HIV prevalence among rural populations that had a high HIV prevalence at baseline.(9) In another study in Lesotho, a drought in the past two years was linked with higher HIV prevalence among adolescent girls in rural areas, but not among boys.(8) Baker modelled the effects of climate change using datasets including 400,000 persons across 25 Sub-Saharan African countries, specifically examining impacts of long-term temperature increases on HIV prevalence.(34) Warmer time periods were associated with increased HIV prevalence, and this increase was higher in rural regions and with younger age groups, and may be linked with men’s migration and engagement in transactional sex.(34) The effects of climate change are often unequal and disproportionately impact populations who have contributed the least to the crisis.(2,35,36) The 2020 Lancet Countdown report indicates that climate change and its contribution to extreme weather events and rising sea levels will increase human migration and displacement, both of which pose risks to human health,(2) including sexual health.(37,38)

An ecosocial theoretical approach considers how hazardous environments, poverty, and social inequities are embodied.(39) The resource scarcity framework conceptualizes shared structural drivers as social (e.g. gender norms), economic (e.g. poverty), and ecologic (e.g. climate change) factors that contribute to water and food insecurity and ultimately to wellbeing.(40,41) Several conceptual frameworks have linked ecosocial factors to HIV and STI vulnerabilities and other sexual health concerns. Tallman et al. applied the ecosyndemic approach to understand the ways through which building dams and highways in tropical forests in Brazil and Peru was linked with vector-borne infections, sex work, and increased STIs.(42) The ecosyndemics framework examines the ways in which largely human-caused environmental changes interact with economic and social inequities to harm health.(43–45) Mapping ecosyndemic risk hotspots and community engagement can provide insight into how social and ecological system changes interact to shape STI and other health concerns.

Lieber et al. conceptualized four paths from climate change to HIV and AIDS, including increased migration, infectious diseases, infrastructure erosion, and food insecurity.(5) For instance, extreme weather events such as drought and flooding have been linked with elevated sexual risk practices including condomless and transactional sex (8,46) and early sexual debut.(9) Extreme weather events may also result in long and short-term migration (47–50) that is associated with increased sexual networks and sexual exploitation.(51,52) Infectious diseases, such as malaria, dengue, chikungunya, and Lyme disease, may increase in prevalence and distribution due to changes in season duration, rainfall, and rising temperatures.(5,53–55) For people living with HIV, who may be immunocompromised, such infectious diseases could become more harmful and contribute to poorer HIV outcomes. (56–58) Infrastructure erosion can also compromise healthcare access. Extreme weather events may disrupt HIV testing and prevention access such as in post-cyclone,(59) hurricane (60) and earthquake settings.(61) Food insecurity, as described earlier, has complex links with HIV acquisition risks and is exacerbated among persons living with HIV.(21,62)

In another recent framework, Women Deliver conceptualized paths from climate change to sexual and reproductive health outcomes, including disruptions in access to health services, as described above, as well as increased exposure to sexual and gender based violence (SGBV).(6) Extreme weather events such as drought and flooding have been linked with SGBV.(63) For instance, drought is associated with physical and sexual violence in 19 Sub-Saharan African countries—effects are exacerbated for adolescent girls.(63) Conflict arising when women have insufficient water to complete household tasks can contribute to intimate partner violence (IPV),(41,64) and women may also be at greater risk for non-partner violence while collecting water.(65) Food insecurity is also linked with IPV.(66,67) In addition to sexual violence's direct HIV risks,(68) SGBV increases HIV acquisition risks via trauma-related sequelae,(69) such as lower condom efficacy and coping-related substance use.(70,71)

These conceptual frameworks signal the urgent need to understand and address climate change and its impacts on sexual health, which is a core component of overall health and wellbeing.(72,73) Sexual health is multifaceted, described by The World Health Organization (WHO) as:

A state of physical, emotional, mental and social well-being in relation to sexuality; it is not merely the absence of disease, dysfunction or infirmity. Sexual health requires a positive and

respectful approach to sexuality and sexual relationships, as well as the possibility of having pleasurable and safe sexual experiences, free of coercion, discrimination and violence. (p.3)(72)

Four components of sexual health conceptualized by the WHO include: comprehensive sexuality education and information; SGBV prevention, support, and care; preventing and controlling HIV infection and other STIs; and addressing sexual function and psychosexual counselling.(72,73) There appears to be a dearth of scoping reviews that systematically map the evidence on climate change and related processes, and sexual health outcomes, as conceptualized by the WHO.(72,73)

Scoping review approaches hold particular relevance in the field of climate change and health—including providing an overview of evidence, assessing types of evidence, exploring how key concepts are defined and conceptualized in the literature, and identifying knowledge gaps.(74,75) We identified three relevant scoping reviews on climate change and sexual health, yet none apply both a comprehensive definition of climate change and sexual health for persons of all genders. First, Thurston et al. (2021) examined natural hazards, disasters, and violence against women and girls in a mixed-methods systematic review.(76) This review found that natural disasters—caused by climatological, geophysical, hydrological, and meteorological hazards—were associated with violence against women and girls in diverse contexts.(76) While Thurston et al. included climate change as a hazard, the other dimensions of sexual health beyond SGBV were not included, and their review was limited to women and girls. Second, Fatema et al. published a systematic review protocol on women’s health-related vulnerabilities in natural disasters, which focused on physical and psychological health and sexual harassment (77). While of importance, this review was also limited to women and girls and did not focus on the full spectrum of sexual health outcomes. Third, a recent narrative synthesis by Loewen et al. examined natural disasters and disease epidemics (e.g. Ebola) and related sexual and reproductive health outcomes in low- and middle-income countries (LMIC).(78) This review only included studies with a health outcome focus on contraception and/or abortion services;(78) while sexual and reproductive health are interconnected, the WHO differentiates reproductive health (abortion care, contraception), which was measured in Loewen et al.’s review, from sexual health (e.g. HIV and STI).(72,73) The review focused on acute disruptions, excluding protracted crises such as drought. Loewen et al. included 13 studies in the review, and the Sub-Saharan Africa studies (n=8) focused on Ebola outbreaks while the other studies in Asia and the Caribbean examined natural disasters (earthquake, flood).(78) Loewen et al found that structural damages to health systems resulted in access barriers; they additionally found an overall decrease in contraception (including male condom use) and family planning use in the midst of, and directly following, disruptive events.(78)

Our scoping review will build on these prior reviews to address knowledge gaps in how the wide-ranging effects of climate change, both acute and protracted, affect the range of sexual health outcomes among all genders and global contexts. Specifically, it will address the following research question: *what is known in the literature about the associations between climate change and sexual health?*

METHODS AND ANALYSIS

This scoping review explores the linkages between climate change and sexual health using the framework developed by Arksey and O'Malley (79) and further developed by the Joanna Briggs Institute.(75,80) The reporting for this review will also follow the guidelines outlined in the Preferred Reporting Items for Systematic Review and Meta-Analysis extension for scoping reviews (PRISMA-ScR).(81,82)

Defining sexual health

The search strategy and eligibility criteria pertaining to sexual health were informed by the WHO's framework for operationalizing sexual health.(72,73) The WHO identifies sexual and reproductive health as distinct but interrelated concepts. While sexual health may encompass a person's fertility capacity and status, it also includes periods in advance of and following a person's reproductive years.(73) As such, we focus this review on the four sexual health intervention areas from the WHO framework(72,73): (1) comprehensive sexuality education and information (including information on sexuality and reproduction, and empowerment and skills for enacting informed choices regarding sexuality and sexual health); (2) SGBV experiences and access to prevention, support and care (this includes violence targeting any gender, including sexual and gender minorities; and physical, sexual and/or emotional violence); (3) preventing and controlling HIV infection and other STIs (this includes oral, anal, and vaginal transmission; STIs including gonorrhea, syphilis, HIV, chlamydia, and herpes simplex virus; and access to testing, prevention and treatment); and (4) sexual function and psychosexual counselling (including addressing psychological, physical, physiological, and interpersonal factors associated with sexual concerns and sexual satisfaction).(72,73) The search strategy specifically includes search terms related to HIV in addition to those related to STIs more broadly, as is outlined in the framework.

Defining climate change: extreme weather events

The search strategy and eligibility criteria pertaining to climate change were informed by the field of planetary health (4) and the work of Bell and colleagues on extreme weather events.(3) Though there is no single definition of an extreme weather event, researchers within the field of climate change have suggested that this can be broadly defined as "climate-related events that rarely occur at a given location or have significant socioeconomic impacts." (3) We will follow examples provided by Bell and colleagues who identify droughts, heat waves, wildfires, dust storms, hurricanes, flooding rains, coastal flooding, and storm surges as comprising extreme weather events, specifically due to their identified linkages to climate change.(3)

Search strategy

In consultation with a University of Toronto librarian, electronic databases were assessed for their relevance and potential coverage of the topic. After careful review, five databases were selected for the search, MEDLINE, EMBASE, PsycINFO, CINAHL, and Web of Science. These will be searched for relevant articles using a search strategy including text words and subject headings (e.g., MeSH, Emtree) related to sexual health and climate change, as defined above, from the inception of each database to May 2021. These terms include:

- sexual health (including sex education, sexual health counselling, sexually transmitted infections, HIV/AIDS); OR
- sex- and gender-based violence (including sexual, physical, and emotional violence, domestic and intimate partner violence, rape); AND
- climate change, extreme weather events, natural disasters (specifically, droughts, heat waves, wildfires, dust storms, hurricanes, flooding rains, coastal flooding, and storm surges)

For a complete search strategy, please see **Appendix I**. Searches will not be limited by language, year of publication, or geographic location. Records returned from this search will be managed in EndNote and Covidence.(83) A manual search of the reference lists of included studies will be conducted to identify additional literature that might not have been captured in our original search. In addition, the research team will supplement the database searches with grey literature following a comprehensive search guide developed by Godin and colleagues (84) and adapted by librarians at both the University of Waterloo and the University of Toronto.(85) Informed by this guide, the following relevant authorities were identified and their websites will be searched for unpublished reports and grey literature: the WHO, the World Bank eLibrary, the Centers for Disease Control and Prevention, Women Deliver, the International Planned Parenthood Association, the NAP Global Network, the Asian-Pacific Resource and Research Centre for Women, and The United Nations. As with the database search, the grey literature search will not be limited by language, year of publication, or geographic location. Reference lists from identified reports will also be reviewed to identify any additional reports that may not have been captured through the initial search.

Study selection

Title & abstract screen

The screening process will be compatible with the PRISMA-ScR standards recommended for peer-reviewed publications.(81,82) Articles will not be assessed for quality as is practiced in systematic reviews, as this is not typically done in scoping reviews;(75,81) and the purpose of this scoping review is to synthesize and identify themes within the available and included literature. Following the removal of duplicates, two reviewers (reviewers include ACR, DT and KM) will independently assess all identified titles and abstracts for eligibility. Quantitative, qualitative, mixed-methods, and review articles will be considered for inclusion. To be included in the full text review, articles must discuss some facet of sexual health (including sex education, sexual health counselling, sexually transmitted infections) and/or SGBV (including sexual, physical and emotional violence, domestic and intimate partner violence, rape) in the context of climate change and/or extreme weather events. Articles will be excluded if their primary populations of interest are infants or children (aged <10 years old) or if they explore sexual health or SGBV separately from climate change or extreme weather events. Additionally, conference abstracts, protocols, books or book reviews, studies conducted in animals, as well as studies for which full text articles are not available, will be excluded. Reviewers will review a random sample of articles to confirm a common interpretation of the above criteria. Covidence software (83) will be used for screening and to monitor agreement between the two reviewers’

assessments. Any differences will be resolved through discussion and consensus, if consensus cannot be reached, articles will be moved to the full-text screen for further review.

Full text screen

The full text screen will be completed independently by two reviewers (ACR, DT, and/or KM) using the same criteria outlined above. As with the title and abstract screen, Covidence software will be used to conduct the screening and monitor agreement between the reviewers' assessments. All differences in screening will be resolved through discussion and consensus of the two reviewers, or in consultation with a third reviewer if needed. The reference lists of articles meeting the criteria for full-text review will be manually searched for additional articles relevant to the review.

Data charting and synthesis

The following data will be extracted from all included studies: study details (i.e., location, duration, design, population, sample size, data source, type of extreme weather event, type of sexual health outcome) and key findings (i.e., impact of extreme weather event on sexual health, duration of impact, implications). Data extraction will be completed by one reviewer (ACR, DT, and/or KM) and peer reviewed by a second (ACR, DT, and/or KM). Data synthesis will involve analyzing the findings from identified studies using thematic analysis approaches.^(86,87) Studies will be grouped into the four domains of sexual health described above (comprehensive sexuality education, SGBV, HIV and STI, and psychosexual counselling). We will apply sex and gender-based analyses ⁽⁸⁸⁾ to explore sex/gender differences in findings as well as integration of sex and gender factors in included studies; this will inform a discussion of gender norms and their linkage to climate change, extreme weather events, and sexual health. Where relevant, we will also identify intersectional identities ⁽⁸⁹⁾ and the socio-demographic characteristics documented in studies (including but not limited to gender, age, sexual orientation and gender identity, refugee status, income, parenthood status, LMIC, sex work), and how those are included in studies and any linkages to climate change and/or sexual health impacts. We will aggregate themes to synthesize overall findings, as well as disaggregate findings by gender, type of climate change/extreme weather event (e.g., drought vs. flood), and by LMIC vs. high-income country. We will also examine similarities and differences between LMIC, for instance, between Sub-Saharan African and Caribbean contexts. Data will be presented both in narrative and tabular forms.

Patient and public involvement

There will be no patient or public involvement in this research.

ETHICS AND DISSEMINATION

As this review involves a synthesis and presentation of available resources, it does not require ethics approval. Results will be published in a peer-reviewed journal, developed into easily disseminated infographics, and shared at international conferences.

DISCUSSION

This review is unique in looking at the impacts of climate change on a range of comprehensive sexual health outcomes among diverse populations. This review will provide a thematic overview of the literature on the global impacts of climate change on sexual health, offering new insight into the types of sexual health outcomes that have been assessed, sex and gender-based analyses,(88) and contexts that have been included or overlooked in climate change and sexual health literature. Thus, by mapping the existing evidence, this scoping review will identify knowledge gaps and research and policy priorities. For instance, this review could support existing sexual health programs and organizations to address the impacts of climate change. By doing so, programs can be better prepared to adapt to climate change, extreme weather events, and other environmental disasters. Based on available findings, we also aim to produce regional specific findings, both between LMIC and high-income contexts and within LMIC, to inform recommendations for practice, policy, and research. Moreover, the review will identify potential gaps in the existing literature to support policy makers and researchers to develop research questions and interventions to improve the delivery of sexual health services in the context of a changing climate.

There are several limitations to this review. The terminology around climate change and extreme weather events, the key concepts in this review, is continuously evolving. It is likely that newly emerging terms are not encompassed in our search strategy, which may result in relevant literature being missed. Furthermore, though we selected the five searched databases based on their relevance and coverage of the topics of interest, there may be peer reviewed articles not indexed by these databases that are missed by our search. To combat this, we will manually search the reference lists of included articles to identify any additional literature relevant to our review. Finally, though the inclusion of a grey literature search is a strength of this review, we acknowledge that grey literature searches are imperfect and relevant documentation may be missed.

Current study status

The search strategy was developed in collaboration with a University of Toronto librarian, has been translated for each of the five databases. All five database searches have been run and title/abstract screening is underway.

Contributors: CHL conceptualized the study and was responsible for drafting protocol. ACR and DT substantially contributed to drafting protocol and led writing of the methods. They developed and refined the search strategy in collaboration with the librarian, and significantly contributed to inclusion/exclusion criteria, methods, and tools. ACR, DT and KM refined the inclusion/exclusion criteria. PAN was a grant co-applicant and provided manuscript feedback. SW, OH, IB, and AA provided manuscript feedback and edits. All authors read, revised and approved the final manuscript.

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- reviews, a type of knowledge synthesis, follow a systematic approach to map evidence on a topic and identify main concepts, theories, sources, and knowledge gaps. Although more scoping reviews, a type of knowledge synthesis, follow a systematic approach to map evidence on a topic and identify main concepts, theories, sources, and knowledge gaps. Although more
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Appendix I: Search Strategy - Sexual Health x Planetary Health

MEDLINE

- 1. Domestic Violence/ or (domestic adj3 (abus* or violen*)).tw,kf.
- 2. exp Intimate Partner Violence/ or ((partner* or spous* or wife or wives) adj3 (abus* or violen*)).tw,kf.
- 3. Gender-Based Violence/ or (gender-based violence).tw,kf.
- 4. Sex work/ or (sex work).tw,kf. or (sex adj3 industr*).tw,kf. or (prostitut*).tw,kf. or (sex* adj1 transact*).tw,kf.
- 5. Rape/ or rape.tw,kf.
- 6. Sex Offenses/ or Sexual Health/ or Sex Education/ or Sex Counseling/ or (sex* adj3 (abus* or offen* or health or educat* or counsel*)).tw,kf. or (family planning).tw,kf.
- 7. exp Sexually Transmitted Diseases/ or ((sexually transmitted or venereal) adj3 (diseas* or infect*)).tw,kf. or (sti or stis).tw,kf. or (std or stds).tw,kf.
- 8. exp HIV Infections/ or (HIV adj3 infect*).tw,kf.
- 9. exp Syphilis/ or syphilis.tw,kf.
- 10. exp Chlamydia/ or exp Chlamydia Infections/ or chlamydia.tw,kf.
- 11. Gonorrhea/ or gonorrhea.tw,kf.
- 12. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11
- 13. exp Natural Disasters/ or ((natural adj3 disaster*) or drought* or wildfire or (flood* adj3 (rain* or coast*)) or (storm surge) or (dust storm) or hurricane* or (tropical storm*)).tw,kf.
- 14. exp Extreme Weather/ or (heat wave* or extreme weather).tw,kf.
- 15. exp Climate Change/ or ((climate adj1 chang*) or (sea level* adj1 (rise* or rising))) .tw,kf.
- 16. 13 or 14 or 15
- 17. 12 and 16

EMBASE

- 1. domestic violence/ or (domestic adj3 (abus* or violen*)).tw,kw.
- 2. exp partner violence/ or ((partner* or spous* or wife or wives) adj3 (abus* or violen*)).tw,kw.
- 3. exp gender based violence/ or gender based violence.tw,kw.
- 4. prostitution/ or (sex work).tw,kw. or (sex adj3 industr*).tw,kw. or (prostitut*).tw,kw. or (sex* adj1 transact*).tw,kw.
- 5. rape/ or rape.tw,kw.
- 6. sexual crime/ or sexual health/ or sexual education/ or sexual counseling/ or (sex* adj3 (abus* or offen* or health or educat* or counsel*)).tw,kw. or (family planning).tw,kw.
- 7. exp sexually transmitted disease/ or ((sexually transmitted or venereal) adj3 (diseas* or infect*)).tw,kw. or (sti or stis).tw,kw. or (std or stds).tw,kw.
- 8. exp Human immunodeficiency virus infection/ or (HIV adj3 infect*).tw,kw.
- 9. exp Syphilis/ or syphilis.tw,kw.
- 10. exp Chlamydia/ or exp Chlamydia Infections/ or chlamydia.tw,kw.
- 11. Exp Gonorrhea/ or gonorrhea.tw,kw.
- 12. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11
- 13. natural disaster/ or (natural adj3 disaster*).tw,kw.

14. exp environmental impact/ or (drought* or wildfire or (flood* adj3 (rain* or coast*)) or (storm surge) or (dust storm) or hurricane* or (tropical storm*) or (sea level* adj1 (rise* or rising))).tw,kw.
15. exp extreme weather/ or (heat wave* or extreme weather).tw,kw.
16. exp climate change/ or (climate adj1 chang*).tw,kw.
17. 13 or 14 or 15 or 16
18. 12 and 17

PsycINFO

1. domestic violence/ or (domestic adj3 (abus* or violen*)).tw
2. intimate partner violence/ or ((partner* or spous* or wife or wives) adj3 (abus* or violen*)).tw
3. gender based violence.tw
4. sex work/ or ((sex work) or (sex adj3 industr*) or (prostitut*) or (sex* adj1 transact*)).tw
5. rape/ or rape.tw
6. sex offenses/ or sexual health/ or sex education/ or family planning/ or (sex* adj3 (abus* or offen* or health or educat* or counsel*)).tw or (family planning).tw
7. sexually transmitted diseases/ or ((sexually transmitted or venereal) adj3 (diseas* or infect*)).tw or (sti or stis).tw or (std or stds).tw
8. HIV/ or (HIV adj3 infect*).tw. or (Human immunodeficiency virus adj3 infect*).tw.
9. syphilis/ or syphilis.tw.
10. chlamydia.tw.
11. gonorrhea/ or gonorrhea.tw.
12. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11
13. natural disasters/ or ((natural adj3 disaster*) or drought* or wildfire or (flood* adj3 (rain* or coast*)) or (storm surge) or (dust storm) or hurricane* or (tropical storm*)).tw.
14. climate change/ or ((climate adj1 chang*) or (sea level* adj1 (rise* or rising))).tw. or (heat wave* or extreme weather).tw.
15. 13 or 14
16. 12 and 15

CINAHL

1. MH ("Domestic Violence") OR TI (domestic N3 (abus* or violen*)) OR AB (domestic N3 (abus* or violen*))
2. MH ("Intimate Partner Violence") OR TI ((partner* or spous* or wife or wives) N3 (abus* or violen*)) OR AB ((partner* or spous* or wife or wives) N3 (abus* or violen*))
3. MH ("Gender-Based Violence") OR TI (gender-based violence) OR AB (gender-based violence)
4. MH ("Sex work") OR TI (sex work OR (sex N3 industr*) OR (prostitut*) OR (sex* N1 transact*)) OR AB (sex work OR (sex N3 industr*) OR (prostitut*) OR (sex* N1 transact*))
5. MH ("Rape") OR TI (rape) OR AB (rape)
6. MH ("Sexual Health") OR MH ("Sex Education") OR MH ("Sexual Counseling") OR TI (sex* N3 (abus* or offen* or health or educat* or counsel*) OR TI (family planning) OR AB (sex* N3 (abus* or offen* or health or educat* or counsel*) OR AB (family planning))

- 7. MH (“Sexually Transmitted Diseases+”) OR TI ((sexually transmitted or venereal) N3 (diseas* or infect*)) OR TI (sti or stis or std or stds) AB ((sexually transmitted or venereal) N3 (diseas* or infect*)) OR AB (sti or stis or std or stds)
- 8. MH (“HIV Infections+”) OR TI (HIV N3 infect*) OR AB (HIV N3 infect*)
- 9. MH (“Syphilis+”) OR TI (syphilis) OR AB (syphilis)
- 10. MH (“Chlamydia+”) OR MH (“Chlamydia Infections+”) OR TI (chlamydia) OR AB (chlamydia)
- 11. MH (“Gonorrhea”) OR TI (gonorrhea) OR AB (gonorrhea)
- 12. S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11
- 13. MH (“Natural Disasters+”) OR TI ((natural N3 disaster*) OR drought* OR wildfire OR (flood* N3 (rain* OR coast*)) OR (storm surge) OR (dust storm) OR hurricane* OR (tropical storm*)) OR AB ((natural N3 disaster*) or drought* or wildfire or (flood* N3 (rain* or coast*)) or (storm surge) or (dust storm) or hurricane* or (tropical storm*))
- 14. MH (“Extreme Weather”) OR TI (heat wave* OR extreme weather) OR AB (heat wave* OR extreme weather)
- 15. MH (“Climate Change”) OR TI ((climate N1 chang*) OR (sea level* N1 (rise* OR rising))) OR AB ((climate N1 chang*) OR (sea level* N1 (rise* OR rising)))
- 16. S13 OR S14 OR S15
- 17. S12 AND S16

Web of Science

- 1. TS=((domestic NEAR/2 (abus* OR violen*)) OR ((partner* OR spous* or wife or wives) NEAR/3 (abus* OR violen*)) OR (“gender-based violence”) OR (“sex work*”) OR (sex NEAR/2 industr*) OR (prostitut*) OR (sex* NEAR/1 transact*) OR (rape OR rapist*) OR (sex* NEAR/2 (abus* OR offen* OR health OR educat* OR counsel* OR violen*)) OR (“family planning”) OR ((“sexually transmitted” OR venereal) NEAR/2 (diseas* OR infect*)) OR (STI OR STD OR STIs OR STDs) OR (HIV NEAR/2 (infect* OR syphilis OR chlamydia OR gonorrhea)))
- 2. TS= (((natural NEAR/2 disaster*) or drought* or wildfire* or (flood* NEAR/2 (rain* or coast*)) or (“storm surge*”) or (“dust storm*”) or hurricane* or (“tropical storm*”)) OR (“heat wave*” or “extreme weather”) OR ((climate NEAR/1 chang*) or (“sea level*” NEAR/1 (rise* or rising))))
- 3. #1 AND #2